

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan



Reference Material Certificate

NMIJ CRM 5206-a
No. +++

Multiple BN Delta-layer Film on Arsenic-doped Si Substrate

This certified reference material (CRM) is produced in accordance with the NMIJ's management system and is in compliance with ISO 17034 and ISO/IEC 17025. This CRM is intended for use in controlling the precision of analysis and adjusting the measurement conditions during depth-profile analysis by Secondary Ion Mass Spectrometry (SIMS).

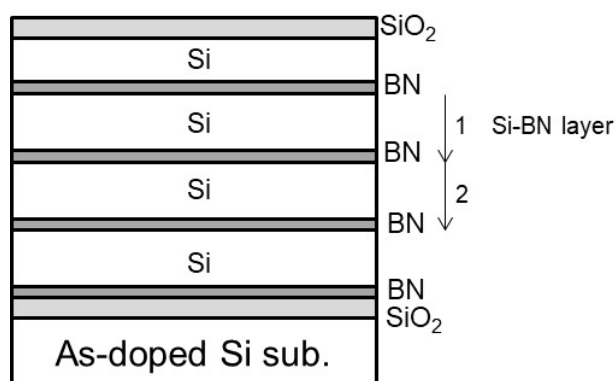
Certified Values

The certified values for the thicknesses of a pair of Si layers and BN delta-layers and the concentration (mass fraction) of As in the substrate are given in the tables below. The uncertainty of the certified value is the expanded uncertainty obtained by multiplying the combined standard uncertainty by a coverage factor (k) of 2, and it is the half-width of an interval estimated to have a level of confidence of approximately 95 %.

	CAS No.	Certified value, Total thickness of Si layer and BN delta- layer (nm)	Expanded uncertainty, Thickness (nm)
Si film with multiple BN delta-layers	Si: 7440-21-3 BN:10043-11-5	8.3	0.2

	CAS No.	Certified value, Mass fraction of As (g/kg)	Expanded uncertainty, Mass fraction (g/kg)
As-doped Si substrate	As:7440-38-2	0.80	0.04

The figure shows a schematic view of the CRM. The four Si layers with inserted BN delta-layer (Si-BN layer) were deposited on the substrate. The thicknesses of one layer of the Si-BN layer shown as 1 and 2 in the figure were certified, except for the uppermost and lowermost structures on the substrate.

**Analysis**

The certified value for the thickness of this CRM was determined by X-ray reflectometry (XRR). The thicknesses of each Si-BN layer shown as 1 and 2 in the figure were evaluated respectively. The average value of these thicknesses was employed as the thickness of one layer of the Si-BN layer. The certified value for the concentration of As was determined by a weighted mean of the evaluated values from instrumental neutron activation analysis (INAA) and inductively coupled plasma mass spectrometry (ICP-MS).

Metrological Traceability

The certified values for the thickness of this CRM were determined based on X-ray wavelengths from the CODATA-recommended values and the calibrated angle. The certified value for the concentration of As was determined based on NIST SRM 3103 [Arsenic (As) standard solution] and Japan Calibration Service System (JCSS) Arsenic standard solution. The certified value is traceable to the International System of Units (SI).

Expiration of Certification

This certificate is valid for one year from the date of shipment, provided that the material is stored in accordance with the instructions given in this certificate.

Description of the Material

This CRM is in the form of a rectangular chip 7.5 mm in width and 15 mm in length, stored in a plastic container. The multiple-delta layer structure was deposited on the polished surface (one side of the chip), and this CRM is placed in a container with the side of sample surface facing down.

Instructions for Storage

The CRM should be stored in a dry and clean environment at a temperature between 5 °C and 35 °C.

Instructions for Use

The certified values of this CRM represent the thickness and the concentration of the entire sample area. In case the measurement area is significantly smaller than the size of the CRM, several points on the CRM should therefore be measured, and the mean value for the results should be obtained. The following international standards can be referred to for the calibration of depth-profile analysis results by SIMS and its related instruments:

ISO 20341:2003 Surface chemical analysis - Secondary-ion mass spectrometry - Method for estimating depth resolution parameters with multiple delta-layer reference materials

ISO 23812:2009 Surface chemical analysis - Secondary-ion mass spectrometry - Method for depth calibration for silicon using multiple delta-layer reference materials

ISO 18114:2003 Surface chemical analysis - Secondary-ion mass spectrometry - Determination of relative sensitivity factors from ion-implanted reference materials

ISO 12406:2010 Surface chemical analysis - Secondary-ion mass spectrometry - Method for depth profiling of arsenic in silicon

Precautions for Handling

Clean gloves and tweezers should be used in handling to prevent contamination. Refer to the safety data sheet (SDS) on this CRM before use.

Preparation

The BN delta-layers and Si films of the CRM were formed by RF magnetron sputtering on a ϕ 100 mm As-doped Si substrate. The chips of the CRM were cut from the wafer and then packed in the plastic container.

NMIJ Analysts

The technical manager for this CRM is KUROKAWA A. The production manager is AZUMA Y. The analysts are AZUMA Y., TAKATSUKA T., NARUKAWA T., and TERAUCHI S.

Information

If substantive technical changes occur that affect the certification before the expiration of this certificate, NMIJ will notify the registered customer. Customer registration on the NMIJ Website (given below) will facilitate notification. Technical reports regarding this CRM can be obtained from the contact details given below.

Reproduction of Certificate

In reproducing this certificate, it should be clearly indicated that the document is a copy.

Note

The determination of As by INAA was performed using the facilities of the Research Reactor Institute, Kyoto University.

April 1, 2020

ISHIMURA Kazuhiko
President

National Institute of Advanced Industrial Science and Technology

If you have any questions about this CRM, please contact:
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Revision history

April 1, 2015: "Metrology Management Center" was renamed to "Center for Quality Management of Metrology."